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TITLE

TELECOMMUNICATIONS INSTALLATION

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a telecommunications installation that has at least one control computer to control the telecommunications installation, in which the control computer has a memory to store control software and work data.

Description of the Related Art

Telecommunications installations of this type, for example, those used as node points in ATM communications networks, are program-controlled, i.e., they comprise one or more control computers to control the functions of the telecommunications installation. Control software in the form of an application program system (APS) is implemented on the control computer. Furthermore, the control computer has a database system to store work data which is used together with the application program system to control the telecommunications installation. Along with a control computer of this type for administrative control of the telecommunications installation, an additional control computer is normally provided to control the actual hardware of the telecommunications installation, i.e., to control the switching system. For reasons of security, the control computers described above are preferably provided in duplicate, in order to avoid total failure of the telecommunications installation in the event of failure of one control computer, via this redundancy thus created.

During the operation of an application program system, destruction of the system software, i.e., the APS file system, or inconsistencies in the databases implemented on the control computers may arise, for example, due to hardware or software faults or as a result of voltage failure or incorrect operation, which cannot be cleared even by means of the previously mentioned redundancy resulting from the duplication of the control computers. Faults may also occur when an application

program system is changed due to incorrect operation or hardware/software problems, which could result in database corruption.

In the event of faults of this type, the application program system, for example, that had been backed up on a magnetic tape, previously had to be loaded into the telecommunications installation again and therefore restored. In the event of database destruction, the database had to be reinitialized and the previously existing connections running via the corresponding telecommunications installation had to be reloaded, for example, with the aid of a batch file. An at least temporary failure of the connections was then inevitable.

In addition to the previously mentioned problems in the event of faults in the APS file system or database of a control computer, known telecommunications installations were also disadvantageous in that, during a test system operation of the relevant telecommunications installation in the event of a test level changeover, a major database modification was often required, which could be relatively time-consuming.

SUMMARY OF THE INVENTION

The present invention is therefore based on the object of producing a telecommunications installation which enables simpler and, in particular, faster changeover of the software of one application program system to the software of another application program system, which is required, for example, if faults occur in the file system of the active application program system. In addition, the present invention is preferably intended to enable simpler test system operation of the telecommunications installation and simpler clearance of faults in the active database of the control computer of the telecommunications installation.

The previously mentioned object is achieved according to the present invention by a telecommunications installation comprising: a control computer to control said telecommunications installation, said control computer comprising: a memory to store control software and work data, said memory comprising a plurality of memory areas, specific control software being allocated to each said memory area, and in that said control software of one of said plurality of memory areas is

declared to be active control software and said control software of other memory areas is declared to be passive control software, so that said control computer controls said telecommunications installation according to said active control software. In the telecommunications installation, specific work data, which are stored by said memory, may be allocated to each control software package, said work data allocated to said active control software being declared to be active work data and said other work data are declared to be passive work data, so that said control computer controls said telecommunications installation according to said active control software and said active work data. The memory may comprise two memory areas to which specific control software and specific work data are in each case allocated. In the invention the two memory areas may comprise identical control software and identical work data, and, in the event of a fault during control of said telecommunications installation, said control computer switches over to and activates previously passive control software and previously passive work data and deactivates said previously active control software and said previously active work data, in order to subsequently control said telecommunications installations according to newly activated control software and newly activated work data. In the event of a fault during said control of the telecommunications installation, and by way of a menu-driven operating intervention, said control computer may switch over to and activate said previously passive control software and said previously passive work data and deactivate said previously active control software and said previously active work data. In the event of a fault during said control of said telecommunications installation, said control computer temporarily can transfer to a pause condition before switching over to said previously passive control software and said previously passive work data. During re-installation of control software, said control computer may continue to control said telecommunications installation according to said active control software; or may temporarily switches to said passive memory area containing said passive control software, in order to install a new work database therein. During a changeover from said active memory area and corresponding control software and corresponding work data to said other memory area and corresponding control software and corresponding work data, said control

computer may evaluate, with reference to stored control information, whether only said control software or else said work data or else a further control computer are affected by said changeover and, depending on this evaluation, automatically initiate a restoration of said telecommunications installation. Finally, in the inventive telecommunications installation, the control computer may comprise an input device to enter control information which declares control software and work data of individual memory areas of said memory to be either active or passive. The invention is explained in more detail below.

According to the present invention, the control computer comprises a plurality of application program systems (APS file systems), which, for example, are set up in different memory areas of the hard disk of the control computer of the telecommunications installation. Only one of these APS file systems is set to be active during a re-installation or changeover of the application program system, while the other APS file systems are declared to be passive. The telecommunications installation is then controlled according to the APS file system which is declared to be active. The switchover from one APS file system to another is simply performed in that the currently active APS file system becomes passive and one of the currently passive APS file systems becomes active.

A corresponding database for work data is advantageously connected to each APS file system. According to the preferred exemplary embodiment, in particular, two pairs of APS file systems/databases are set up on the control computer. The active APS file system and the active database are set up via a special mechanism to start up the telecommunications installation, while the other APS file system and the other database are declared to be passive. The telecommunications installation is then controlled by the control computer on the basis of the active APS file system or corresponding APS software and the work data of the active database. In this way, the disk memory capacity of the control computer is effectively used through declaration of an active and a passive half in order to enable faster changeover between the installed APS file systems or corresponding databases, where, in particular, a fallback position can be created for possible emergencies by transferring a copy of the active APS file system and the

active database to the initially passive memory area of the control computer in such a way that, even if the redundant control computer is unavailable in the event of a fault, operation of the telecommunications installation can be maintained.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is explained in detail below by way of a preferred exemplary embodiment, with reference to the attached drawing.

Figure 1 is a simplified block diagram of a telecommunications installation according to the present invention, and

Figure 2 is a detailed block diagram of the components illustrated in Figure 1, which serve to control the telecommunications installation.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The telecommunications installation 1 shown in figure 1 serves to switch voice, image, text and data connections between the subscribers of a telecommunications network (particularly an ATM telecommunications network) allocated to the telecommunications installation 1. The telecommunications installation 1 preferably operates digitally, i.e., digital information transmission takes place within the telecommunications installation 1.

The telecommunications installation 1 comprises, as central components, a digital switching network 4, which represents the actual switching equipment of the telecommunications installation 1. The switching network 4 enables "physical translocation" from one transmission line connected to the telecommunications installation 1 to another transmission line, and "temporal translocation" from one transmission channel to another transmission channel. The digital switching network 4 is normally divided up into individual switching network modules or switching stages.

Different subscribers and transmission lines, which are fed via line adapters 2a-2c to the digital switching network, are allocated to the telecommunications installation 1. If required, analog/digital conversion is carried out in the incoming direction and digital/analog conversion is carried out in the outgoing direction in the line adapters

2a-2c. The line adapters 2a-2c may be connected, e.g.,via PCM transmission lines having, for example, 64 channels, to the digital switching network 4. For the sake of simplicity, a plurality of subscriber lines 3 are shown in Figure 1 for the line adapter 2a only; these subscriber lines may be allocated to both analog and digital subscriber terminal devices or further network nodes. The line adapters 2b and 2c are also connected in each case to a multiplicity of subscriber lines 3.

The telecommunications installation 1 is program-controlled. This is done with the aid of a controller 5, which receives the connection requests of the subscribers of the telecommunications installation 1, carries out the routing, and controls the entire telecommunications installation 1, particularly the hardware of the telecommunications installation. As explained in more detail below, the telecommunications installation 1 is controlled according to the application program system (APS), which is implemented on the telecommunications installation 1.

In the example shown in Figure 1, the function of the controller 5 is divided up into two halves, which run on two separate computer systems. One computer system, referred to as PCE, is used for administrative control of the telecommunications installation 1, in such a way that the application program system (APS) essentially runs on this computer system. The second computer system, referred to as GPE, is used primarily to control the actual switching system, i.e., particularly the digital switching network 4, of the telecommunications installation 1. In contrast to the computer system PCE, the computer system GPE is therefore more hardware-oriented and supports the switching system processes.

Both computer systems PCE and GPE are provided in duplicate for security, in order to prevent the entire telecommunications installation 1 from crashing if one computer of the relevant computer system fails. According to the embodiment shown in Figure 1, the computer system PCE therefore comprises two control units PCEU0 and PCEU1, which are formed by the control computers 6a and 6b shown in Figure 1. The computer system GPE analogously comprises two control units GPEU0 and GPEU1, which are formed by the control computers 6c and 6d shown in Figure 1. Within the individual computer systems PCE and GPE, each single control computer can therefore perform the function of the other control computer if the latter fails, in

which case one control computer is operated in an active mode and the other control computer is operated in a standby mode. As explained in more detail below, the computer system PCE provides not only operating functions but also nonvolatile memory media of the telecommunications installation 1 and performs central control functions. The computer system GPE on the other hand has no secondary memories and performs the real-time control functions for the peripherals and for the switching network 4 of the telecommunications installation 1.

Figure 2 shows details of the configuration of the controller 5 shown in Figure 1. The control units PCEU0 and PCEU1 can be implemented with normal personal computers 6a and 6b. A mouse 10a and 10b and/or a keyboard 11a and 11b are available as input media. Hard disks 7a and 7b, disk drives 13a and 13b and/or streamer drives 9a and 9b can be provided in each case as secondary memories. Furthermore, a CD-ROM drive 8a and 8b is in each case provided to enter (i.e., load) software. A monitor 12a and 12b is connected to each control computer 6a, 6b, and a printer 14a and 14b, respectively, is additionally allocated to each control computer.

The two partner control computers 6a, 6b are, for example, interconnected via an Ethernet connection 17. The two control computers 6a and 6b can furthermore be connected via the Ethernet connection 17 to a service multiplexer, via which, for example, lines can be connected according to the E1 transmission standard of the relevant telecommunications installation 1. In the embodiment shown in Figure 2, a V.24 connection 16, which serves to locate faults in the event of possible failure of the Ethernet line 17, is routed in parallel with the Ethernet connection line 17.

In order to be able to communicate, inter alia, with remote workstations, each control computer 6a, 6b has connections 18a and 18b, which are designed in the form of an X.25 connection and are implemented with the aid of a dedicated plug-in card. In addition, interface cards 21a, 21b are provided, via which the control units PCEU0 and PCEU1 can be connected with the aid of corresponding connections 22a and 22b to the control units GPEU0 and GPEU1, which are implemented by the previously mentioned control computers 6c and 6d.

Finally, for synchronization, a remotely controlled clock 15 is also provided, which is preferably connected via V.24 interfaces to the two control computers 6a, 6b. However, a radio clock 15 of this type is provided only in telecommunications installations which are designed as central units.

Finally, the control units GPEU0 and GPEU1 implemented with the control computers 6c, 6d are connected to the switching network 4 shown in Figure 1 and the peripherals of the telecommunications installation 1, and furthermore have connections to output fault messages. Additionally, these two control computers 6c and 6d are interconnected via a link-channel 23 to exchange hardware status messages with one another.

UNIX can be used as the operating system on the control units PCEU0 and PCEU1, and also a user interface based on X-Windows and the OSF-Motif. The ORACLE relational database management system is preferably used for data organization.

With the redundancy implemented with the control computers 6a and 6b, and 6c and 6d, only one of the control computer pairs 6a and 6b, and 6c and 6d, is active, while the other of the relevant control systems PCE and GPE is in standby mode. Only a restricted, rather than the complete, command scope (e.g., configuration commands) is offered on the relevant standby control computer, in order to turn the standby computer into the active control unit.

When activated, the two control computers 6a and 6b of the computer system PCE control the telecommunications installation 1 in each case depending on the software of an activated application program system (APS) and the work data of an activated database. This is explained in detail below with reference to the control computer 6a serving as the control unit PCEU0.

As shown in Figure 2, the control computer 6a accesses a specific data stock 24 which comprises the software for the application program system and the database. This data stock 24 is located on the hard disk 7a of the control computer 6a. According to the present invention, the data stock 24 comprises a plurality of APS file systems and preferably also databases, in each case only one pair of APS file systems/databases being activated and the other pairs being deactivated.

According to the preferred exemplary embodiment shown in Figure 2, two pairs of APS file systems/databases are set up, in which one memory area 19 has the software for one APS file system APS1 and the work data for a database DB1, while another memory area 20 comprises the software for a further APS file system APS2 and the memory area for a further database DB2. The APS file system APS1, along with the database DB1, forms an associated pair, whereas the APS file system APS2, along with the database DB2, likewise forms a corresponding pair. Alternatively, situations are also possible in which the two APS file systems APS1 and APS2 interwork with the same database DB1 or DB2. This may arise following an APS changeover without modifying the database functionality on economic and time-saving grounds.

The relevant active APS file system and the active database are set in each case in the control computer 6a by way of corresponding control information via a special mechanism in the event of a re-installation or changeover of the application program system or a changeover between different application program systems. The exemplary embodiment shown in Figure 2 assumes that the APS file system APS1 is initially set as the active APS file system and the database DB1 is set as the active database.

With the aid of the configuration shown in Figure 2, a simple APS changeover can be carried out accordingly by deactivating the APS file system APS1 and by activating the other APS file system APS2. A simple database changeover can be correspondingly implemented by deactivating the database DB1 and by activating the database DB2. An APS changeover of this type is appropriate particularly in the event of operational disruption, if no correct control of the telecommunications installation 1 can be implemented with the aid of the initially active APS file system APS1. However, in the case of an APS changeover of this type, the computer 6a must temporarily assume an undo or pause setting in order to avoid an overlap of the active and passive positions of the individual APS file systems or databases.

During periods of little or no operation, a fallback position can be very simply created for the control computer 6a by copying the contents of the initially active memory area 19 into the passive memory area 20 in such a way that the passive

APS file system APS2 corresponds to the active APS file system APS1 and the passive database DB2 corresponds to the active database DB1, in order to guarantee reliable control of the telecommunications installation in a possible emergency, even if the redundant PCE control computer 6b is unavailable, by changing over to the memory area 20 with the APS file system APS2 and the database DB2.

During the installation of an application program system, the application program system which is still active remains active. Only if a database changeover is required during installation is there a need for a temporary changeover to the passive database (in the example shown in Figure 2, to the database DB2) in order to initialize a new database there and start the data transfer.

In terms of an APS changeover, a distinction is made between different types of a changeover of this type. Thus, for example, only the APS file system may be affected by a changeover of the application program system, so that, in this case, only the currently active APS file system is shut down and the new APS file system needs to be started up. If, on the other hand, the database memory area is also affected, the old database must also be shut down and the new database started up. In addition, the entire control computer is fully rebooted. The GPE control computer may equally be affected by an APS changeover, so that, in this case, the GPE control units GPEU0 and GPEU1 must also be re-initialized if required. In order to control these different cases of APS changeovers, a specific restore or recovery stage must be allocated to each APS changeover, and is stored in the control computer 6a in the form of corresponding control information. With the occurrence of an APS changeover, the control computer 6a can determine and apply the relevant recovery stage with the aid of this control information, in order to carry out the controller restoration as effectively as possible in this way. The redundancy requirements must essentially be observed here, i.e., the relevant APS file system/database pairing must match, the active control computer remains active and the control computer in standby mode must be shut down to prevent interference with the controller.

It is evident from the above description that, according to the present invention, only one APS file system/database pair is active. The other, initially passive, pair can be accessed, for example, via a fallback mechanism in the event of an emergency via the active application program system or, for example, in test system operation in the event of a test level changeover, via the application program system of the preceding test layer, in order to activate this APS file system/database pair.

In the exemplary embodiment shown in Figure 2, only two pairs of APS file systems/databases are set up. However, the present invention can be applied to more than two such pairs, in which case it must be guaranteed that only one of these pairs is activated and the other pairs are deactivated. Furthermore, the controller has been explained with reference to Figure 2 purely in terms of the control computer 6a, i.e., in terms of the PCEU0 control unit. However, the above description also applies analogously to the redundant control computer 6b, i.e., the PCEU1 control unit, in which case a plurality of pairs of APS file systems/databases are likewise advantageously set up and only one of these pairs is activated.

With the aid of the present invention, the capacity of the hard disk of a control computer 6a, 6b can be effectively used in order to quickly carry out an APS changeover and switch over to a new APS. This is particularly advantageous in the event of a test level changeover in test system operation of the telecommunications installation 1. Furthermore, this is advantageous in the event of an emergency, in order to guarantee reliable control of the telecommunications installation by way of an APS changeover even if the redundant control computer is unavailable.

The above-described telecommunication installation is illustrative of the principles of the present invention. Numerous modifications and adaptations thereof will be readily apparent to those skilled in this art without departing from the spirit and scope of the present invention.

ABSTRACT

A telecommunications installation (1) is provided, which is controlled with the aid of at least one control computer (6a, 6b), in which the control computer (6a, 6b) stores control software (APS1, APS2) and work data (DB1, DB2) for controlling the telecommunications installation (1). A plurality of pairs of control software and work data (APSi; DBi) are set up, where only one of these pairs is set to be active and the other pairs are set to be passive for controlling the telecommunications installation.